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Ponding Test Results
Seepage and Total Losses,
Secondary Canals 13, 16, and 29
Donna Irrigation District
Hidalgo County No. 1

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March 30, 2004

Texas Water Resources Institute
make every drop count

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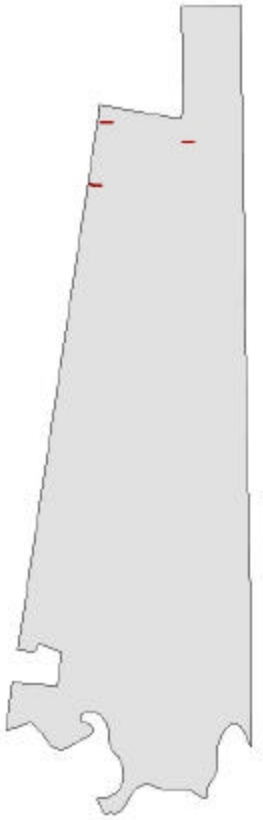

PONDING TEST RESULTS:
SEEPAGE AND TOTAL LOSSES
SECONDARY CANALS 13, 16, AND 29

DONNA IRRIGATION DISTRICT
HIDALGO COUNTY NO. 1

Report Prepared by:

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March 30, 2004

IRRIGATION TECHNOLOGY CENTER
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CONTENTS

CONTENTS (cont.)

Ponding Test Results: Seepage and Total Losses, Secondary Canals 13, 16, and 29, Donna Irrigation District Hidalgo County No. 1

SUMMARY

This report summarizes the results of ponding tests conducted in Donna Irrigation District Hidalgo County No.1 (Donna) on July 22-24, 2003. Tests were conducted on three canal segments located in the northern portion of the district (see Fig. 2):

- Test segment DO1: west off of Val Verde Road, north of Mile 13 ½ N
- Test segment DO2: west off of Val Verde Road, north of Mile 15 N
- Test segment DO3: west of FM 493, south of Mile 15 N

DO1 was a seepage loss tests. However, test segments DO2 and DO3 contained turnout gates that may have contributed to measured losses; thus, the total losses were measured (Fig. 1).

Test results are summarized in Tables 1 and 2 and were as follows:

- The average seepage loss rate measured for Test Segment DO1 was 1.68 gal/ft^2/day.
- Test Segment DO2 had four turnout gates (one turnout gate verified as leaking) and a 2 inch PVC pipeline may have contributed to the total loss rate of 2.18 gal/ft^2/day.
- Test Segment DO3 had three turnout gates (unable to be verified as leaking) that may have contributed to the total loss rate of 2.71 gal/ft^2/day.

Table 1. Summary of ponding test results of the canals 13, 16, and 29.

Test ID	District Segment ID	Soil*	Length (ft)	Avg. Width (ft)	Test Type	Loss rate Gal/ft^2/day	Total Loss in Canal (ac-ft/mile) per day	per year
DO1	Lat 13	Sandy clay loam	1500	4.6	seepage	1.68	0.18	65.2
DO2	Lat 16	Sandy clay loam	1500	6.0	total**	2.18	0.33	121.5
DO3	Lat 29	Sandy clay loam	1500	5.9	total**	2.71	0.29	107.2

* Soil type of the surrounding area from the Soil Survey for Hidalgo County (USDA 1978)
** turnout gates located within the test segment may have contributed to losses

Table 2. Test results for canals 13, 16, and 29 in terms of change in water level.

Test ID	ft/hr	ft/day	in/hr	in/day
DO1	0.017	0.41	0.20	4.91
DO2	0.023	0.55	0.28	6.64
DO3	0.033	0.79	0.40	9.47

Figure 1. Large cracks and turnout gates shown above contribute to higher total losses of canal segments.

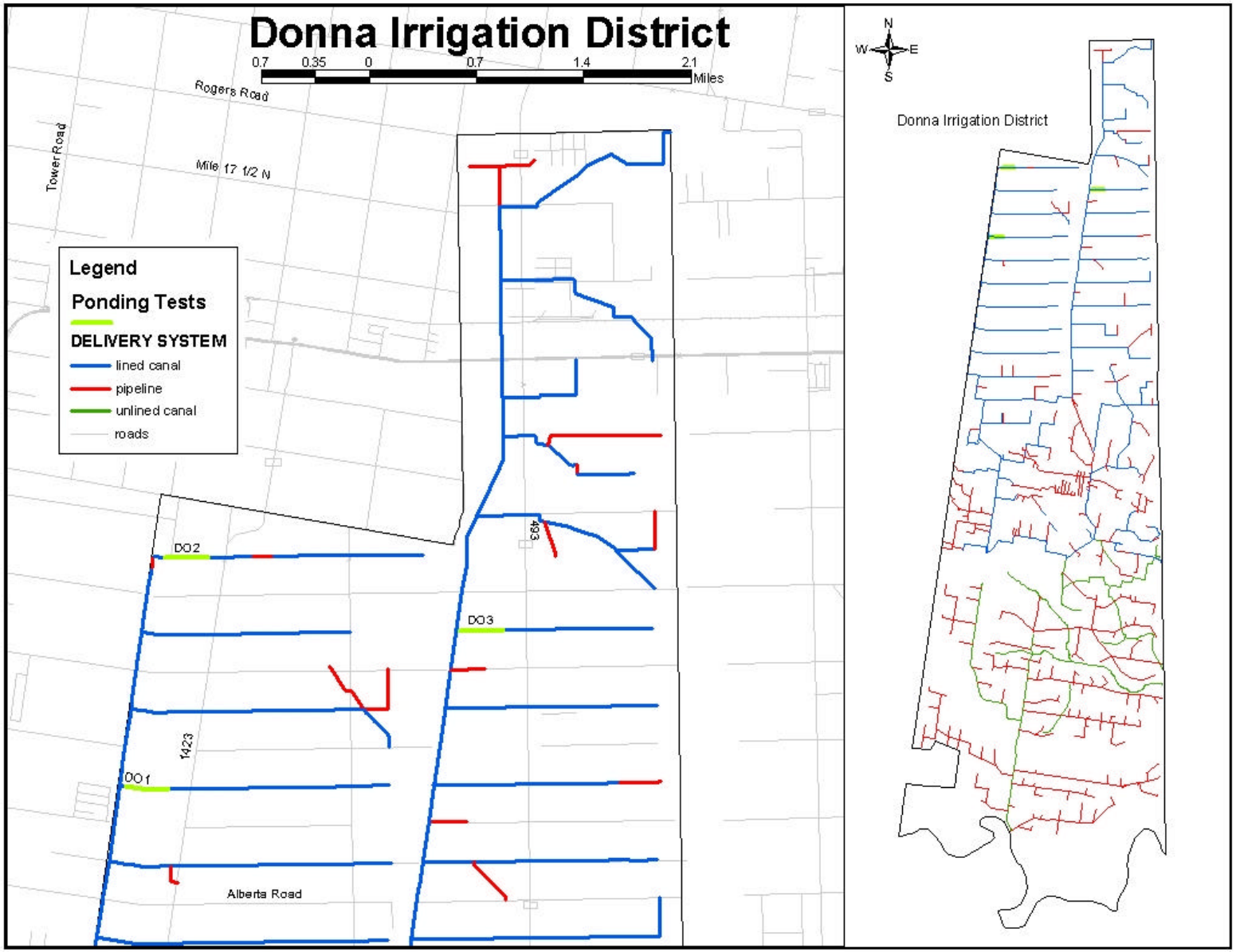

Figure 2. District Map and locations of test segments.

MATERIALS AND METHODS

Canal loss rates were measured using the ponding method. In this method, the two ends of a canal segment are closed or sealed with earthen dams as shown in Figure 3. Once sealed, water elevations are taken for approximately 48 hours. Two staff gauges (Fig. 4) were placed in each test segment, and stage levels were recorded manually. Canal dimensions and water spans were also surveyed during the test.

The tests are classified as follows:

- Test segment DO1 did not contain valves or gates within the canal; thus, the seepage rate was measured.
- Test segment DO2 and DO3 contained several leaking turnout gates (Fig. 5); thus, we classify this as a total loss test since the gates contributed to the measured losses.

Tables 3, 4, and 5 provide details on the test segments, data collected and recorded changes in water depths during the tests. The canal cross-sections at each of the staff gauges are illustrated in Figures 6 - 7 for test DO1, Figures 8 - 10 for test DO2, and Figures 11 - 12 for test DO3. Also shown on these charts are the water depths at the beginning of the test.

Figure 3. One of the earthen dams used in the ponding tests.

Figure 4. Staff gauge use to measure water levels.

Figure 5. A leaking turnout gate leak found in Test Segment DO2.

Table 3. Data for Test DO1: Lateral 13.

District: Donna Irrigation District Hidalgo County No. 1	**Test ID:** DO1
Canal: Lateral 13	**Lining Type:** Lined
Starting Water Span Widths: **A:** 3.54 feet, **B:** 4.5 feet	**Date:** Jul 22-24, 2003
Test Segment Length: 1500 feet	**Start Time:** 4:09 pm **Finish Time:** 3:59 pm
Test Starting Depths: A: 1.62 feet, **B:** 2.27 feet	
Location: west off of Val Verde Road, north of Mile 13 ½ N	

Staff Gage Readings

Date	A		B	
	Time	**Feet**	**Time**	**Feet**
Jul 22	**16:09**	**1.19**	**16:08**	**5.0**
	18:12	**1.09**	**18:10**	**4.89**
	19:33	**1.05**	**19:29**	**4.85**
Jul 23	**09:47**	**0.70**	**09:46**	**4.5**
	13:50	**0.64**	**13:49**	**4.45**
	16:58	**0.60**	**16:56**	**4.4**
Jul 24	**11:02**	**0.41**	**11:01**	**4.22**
	15:59	**0.38**	**15:58**	**4.18**
True depth adjustment factor (ft)		**0.427**		**-2.73**

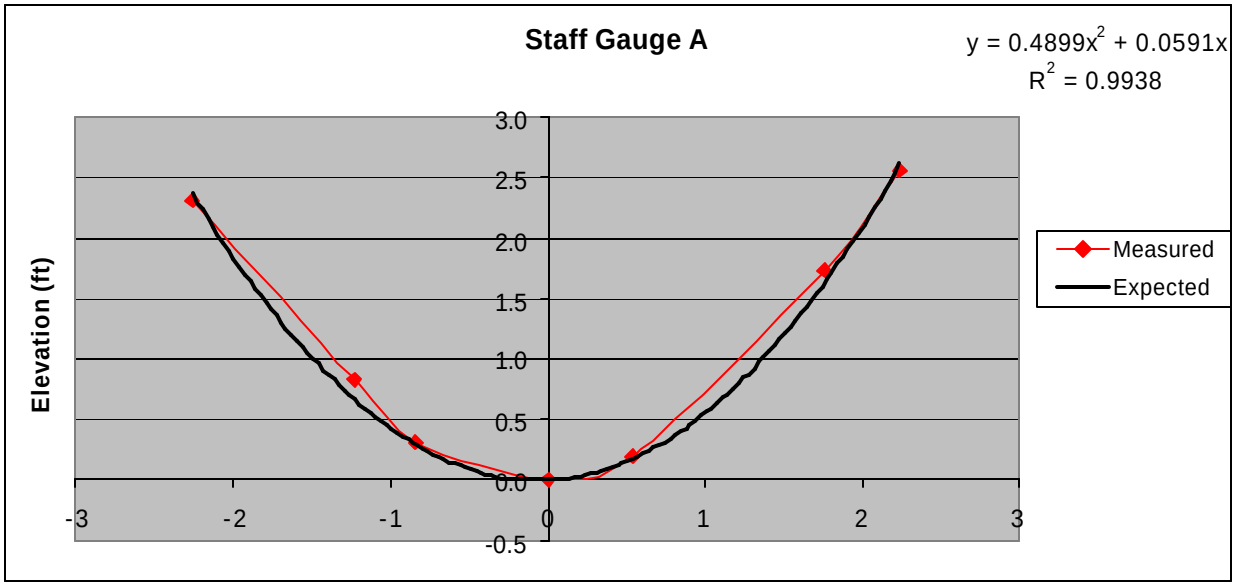

Figure 6. Cross-section at Staff Gauge A, DO1.

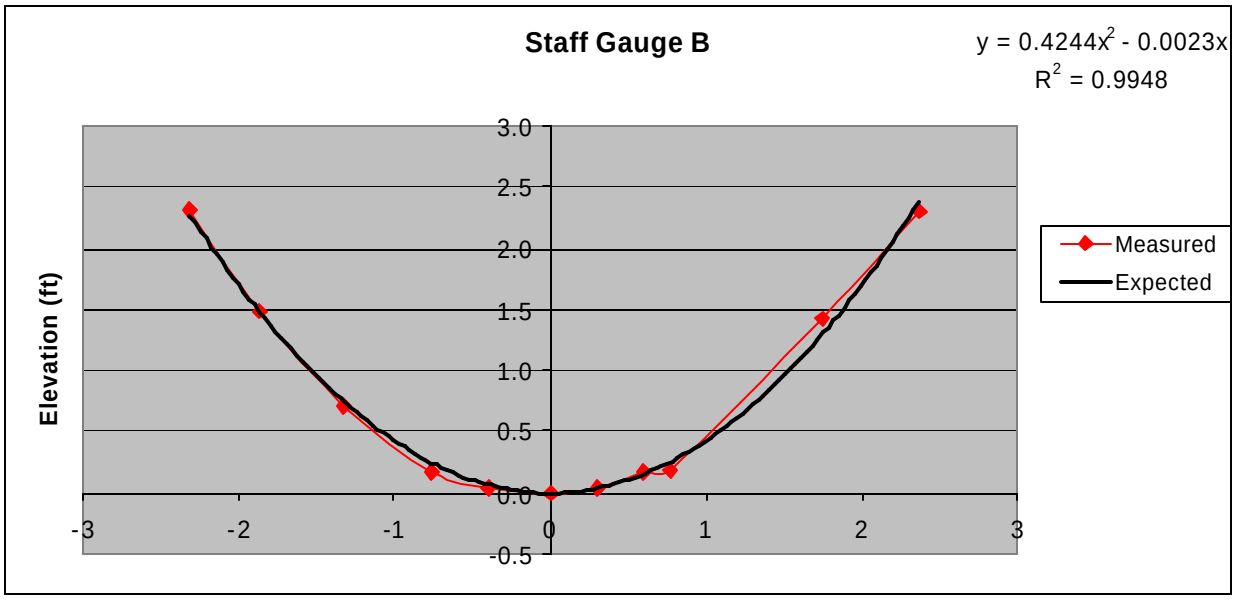

Figure 7. Cross-section at Staff Gauge B, DO1.

Table 4. Data for Test DO2: Lateral 16.

District: Donna Irrigation District Hidalgo County No. 1	**Test ID:** DO2
Canal: Lateral 16	**Lining Type:** Lined
Starting Water Span Widths: **A:** 4.7 feet, **B:** 6.1 feet	**Date:** Jul 22-24, 2003
Test Segment Length: 1500 feet	**Start Time:** 11:56 am **Finish Time:** 1:50 pm
Test Starting Depths: A: 2.75 feet, **B:** 2.90 feet	
Location: west off of Val Verde Road, north of Mile 15 N	

Staff Gage Readings

Date	A		B	
	Time	**Feet**	**Time**	**Feet**
Jul 22	**11:56**	**1..38**	**11:58**	**4.82**
	13:48	**1.16**	**13:47**	**4.60**
	16:01	**0.98**	**15:59**	**4.42**
	17:43	**0.90**	**17:43**	**4.34**
	19:55	**0.82**	**19:54**	**4.26**
Jul 23	**09:55**	**0.56**	**09:53**	**4.00**
	13:59	**0.50**	**13:58**	**3.94**
	16:49	**0.46**	**16:47**	**3.90**
Jul 24	**11:09**	**0.25**	**11:07**	**3.70**
	13:47	**0.22**	**13:50**	**3.67**
True depth adjustment factor (ft)		**1.373**		**-1.916**

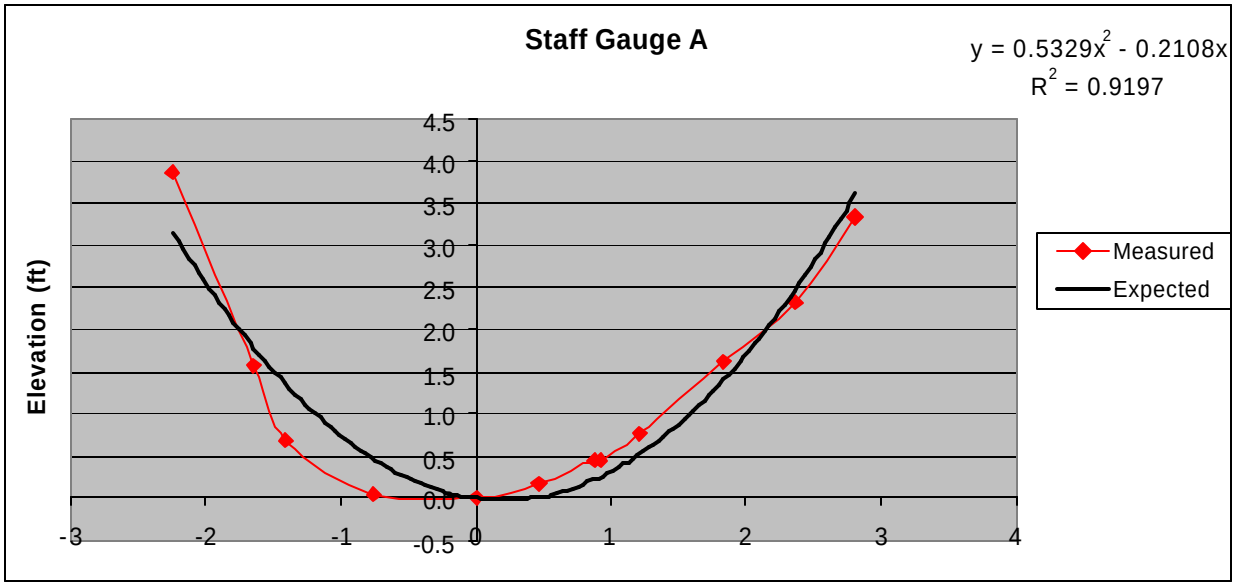

Figure 8. Cross-section of Staff Gauge A, DO2.

Figure 9. Shows test segment DO2 with serious structural problems that has been repaired many times over, and since has change the shape (see Fig. 8).

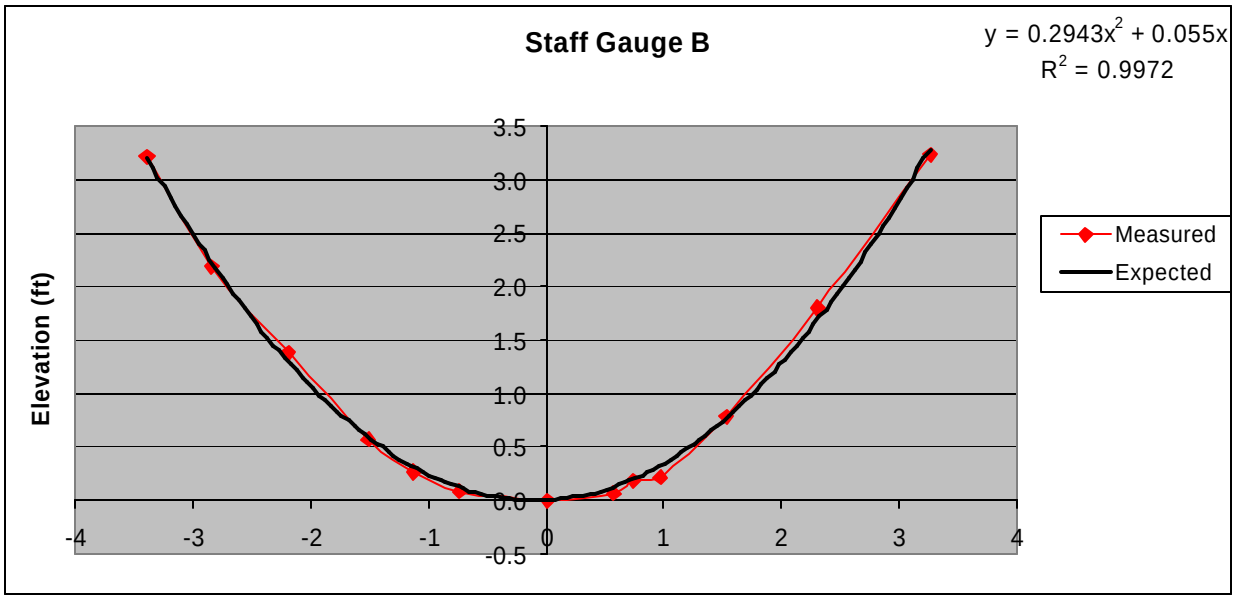

Figure 10. Cross-section of Staff Gauge B, DO2.

Table 5. Data for Test DO3: Lateral 29.

District: Donna Irrigation District Hidalgo County No. 1	**Test ID:** DO3
Canal: Lateral 29	**Lining Type:** Lined
Starting Water Span Widths: **A:** 4.85 feet, **B:** 5.4 feet	**Date:** Jul 22- 24, 2003
Test Segment Length: 1500 feet	**Start Time:** 4:19 pm **Finish Time:** 3:35 pm
Test Starting Depths: A: 1.79 feet, **B:** 2.13 feet	
Location: west of FM 493, south of Mile 15 N	

Staff Gage Readings

Date	A		B	
	Time	Feet	Time	Feet
Jul 22	16:22	1.73	16:19	2.13
	17:30	1.61	17:28	2.01
	18:35	1.53	18:30	1.93
	20:06	1.43	20:04	1.84
Jul 23	10:08	1.10	10:09	1.23
Jul 24	10:53	0.43	10:52	0.65
	15:30	0.16	15:35	0.59
True depth adjustment factor (ft)		0.062		0.00

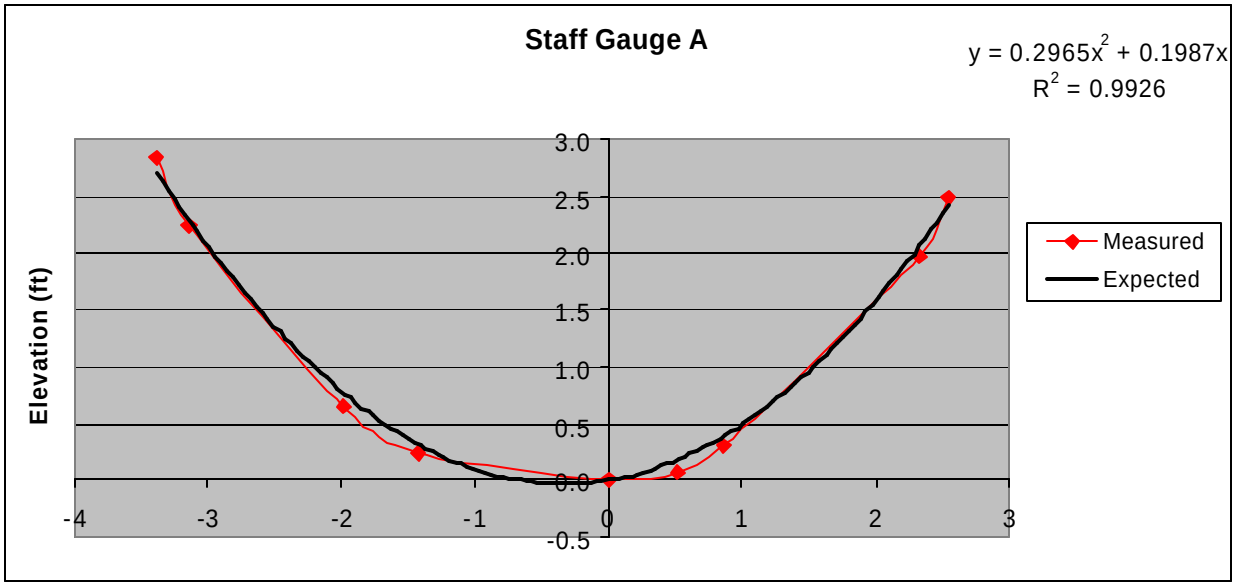

Figure 11. Cross-section for Staff Gauge A, DO3.

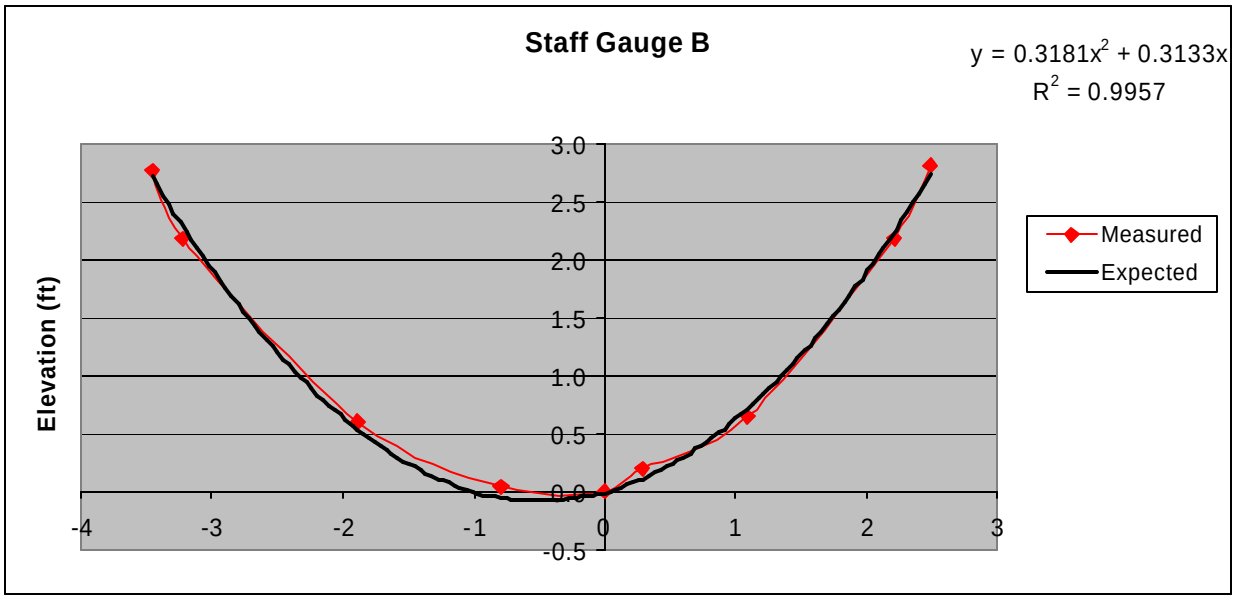

Figure 12. Cross-section for Staff Gauge B, DO3.

SOIL DESCRIPTIONS

General Soil Series

1 – Hidalgo: Deep, moderately permeable soils that typically have dark grayish brown sandy clay loam surface layer (source: Soil Survey of Hidalgo County, Texas USDA, 1978).

Detailed Soil Units

Table 6. Soil Series Key Codes and Permeability Ranges.

Soil Unit	Permeability (in/hr)
28 – Hidalgo sandy clay loam	0.6 – 2.0

OTHER TEST RESULTS

Texas Cooperative Extension has conducted approximately 50 total loss tests and seepage loss tests in the Lower Rio Grande River Basin since 1998. The results are summarized in Tables 7 – 9. Table 10 gives seepage rates versus lining type as reported in the scientific literature.

Table 7. Results of seepage loss tests conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
Lined						
16HC2	03			M		
LF1	03	12	5	M	1.77	152.9
LF2	03	10	6	M	4.61	369.1
MA4	03	12	5	S	8.85	529.7
SJ4	00	15	4	M	1.17	111.2
SJ5	02	14	5	M	1.38	145.5
UN1	01	12	6	M	2.32	217.7
UN2	01	8	3	M	2.09	121.2
Unlined						
BR1	03	60	11	M	3.14	794.6
MA3	03	19	5	S	13.9	1690.1
RV1	03	38	4	M	0.15	23.0
SB4	02	16	4	S	0.64	68.3
SB5	02	18	3	S	1.67	188.3
SB6	02	20	5	S	1.44	189.0
SB7	02	16	4	S	0.42	47.4
SB8	02	20	5	S	0.83	104.0

Classification of canal: M = main, S = secondary

Table 8. Results of total loss tests in lined canals (leaking gates and valves may have contributed to measured loss rates) conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
Lined						
16HC1	03	14	5	M	1.89	192.4
BV1	99	10	5	M	7.97	510.5
BV2	99	9	4	M	8.53	451.5
DL1	00	20	6	M	0.16	18.8
DL2	00	7	4	S	4.12	236.2
DO1	03	5	3	S	1.68	65.2
DO2	03	6	4	S	2.18	121.5
DO3	03	6	3	S	2.71	107.2
ED1	00	6	4	S	34.32	1519.6
ED2	00	6	4	S	21.5	858.2
ED3	00	3	2	T	10.22	308.2
ED4	00	4	3	S	18.72	567.7
ED6	99	9	4	M	8.53	451.5
HA2	00	10	4	M	2.26	135.2
HA3	98	15	2	S	0.64	45.5
ME1	98	38	7	M	1.26	281.9
ME2	98		4	M	1.88	163.5
SJ1	99	12	5	M	2.58	126.8
SJ6	03	12	3	M	1.88	1.63
SJ7	03	19	4	M	1.98	227.1
UN3	02	12	6	M	2.02	154.3

Classification of canal: M = main, S = secondary, T = tertiary

Table 9. Results of total loss tests in unlined canals (leaking gates and valves may have contributed to measured loss rates) conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
BV3	99	55	8	M	0.15	53.4
ED5	02	105	7	M	2.39	1213.2
MA1	99	50	10	M	1.98	227.1
MA2	99	20	5	S	4.32	371.4
SB1	00	29	7	S	1.27	215.5
SJ2	00	23	6	M	2.74	293.2
SJ3	00	30	5	S	0.95	132.6

Classification of canal: M = main, S = secondary

Table 10. Canal seepage rate reported in published studies.	
Lining/soil type	**Seepage rate (gal/ft^2/day)**
Unlined[1]	2.21-26.4
Portland cement[2]	0.52
Compacted earth[2]	0.52
Brick masonry lined[3]	2.23
Earthen unlined[3]	11.34
Concrete[4]	0.74 - 4.0
Plactic[4]	0.08-3.74
Concrete[4]	0.06-3.22
Gunite[4]	0.06-0.94
Compacted earth[4]	0.07-0.6
Clay[4]	0.37-2.99
Loam[4]	4.49-7.48
Sand[4]	4.0-19.45

[1] DeMaggio (1990). Technical Memorandum: San Luis unit drainage program project files. US Bureau of Reclamation, Sacramento. [2] U.S. Bureau of Reclamation (1963). Lining for Irrigation Canals. [3] Nayak, et al. (1996). The influence of canal seepage on groundwater in Lugert Lake irrigation area. Oklahoma Water Resources Research Institute. [4] Nofziger (1979). Profit potential of lining watercourses in coastal commands of Orissa. Environment and Ecology 14(2):343-345.

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